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Biologie et Génétique
des Interactions Plante-Parasite
Equipe BECφ - Biologie Evolutive des Champignons PHYtopathogènes

Black leaf streak disease and eumusae leaf spot: two destructive and invasive leafspot diseases of bananas

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Invasive Alien species symposium, 5 July 2011

Mycosphaerella leaf spot diseases

- Severe foliar diseases of bananas ⟶ large necrosis
- due to ascomycete fungi
- *3 Mycosphaerella* species

- Specific to bananas
- 1st production constraints / exportation

Mycosphaerella leafspot diseases impact

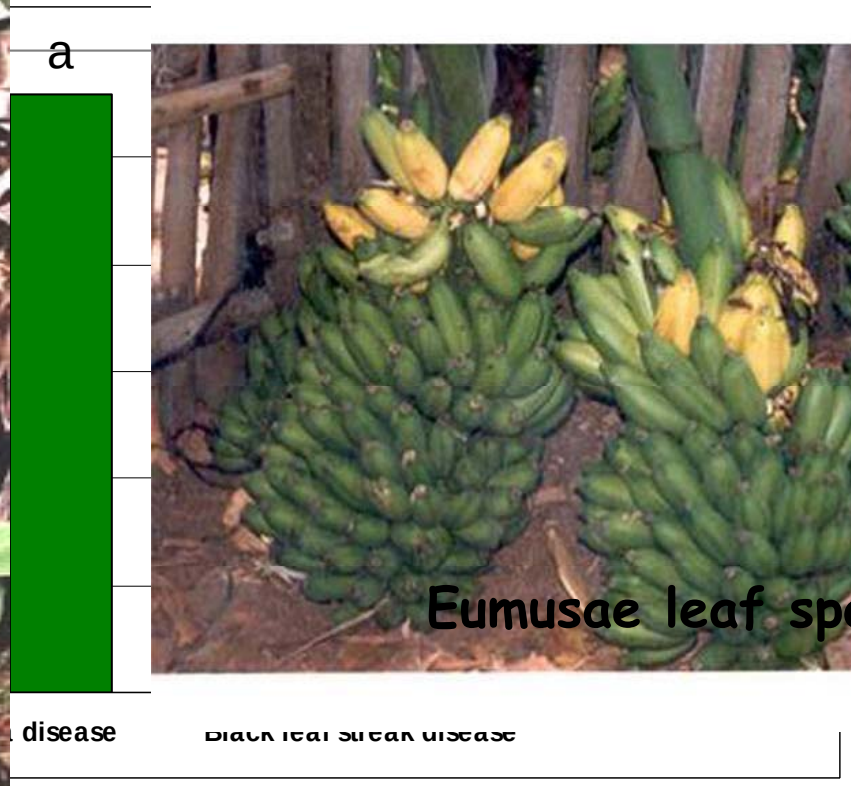
↘ Fruit weight flowering delay

Early ripening

➡ yield reduction (↘ 100 % depending on varieties and climate)

Ripened fruits on bunches

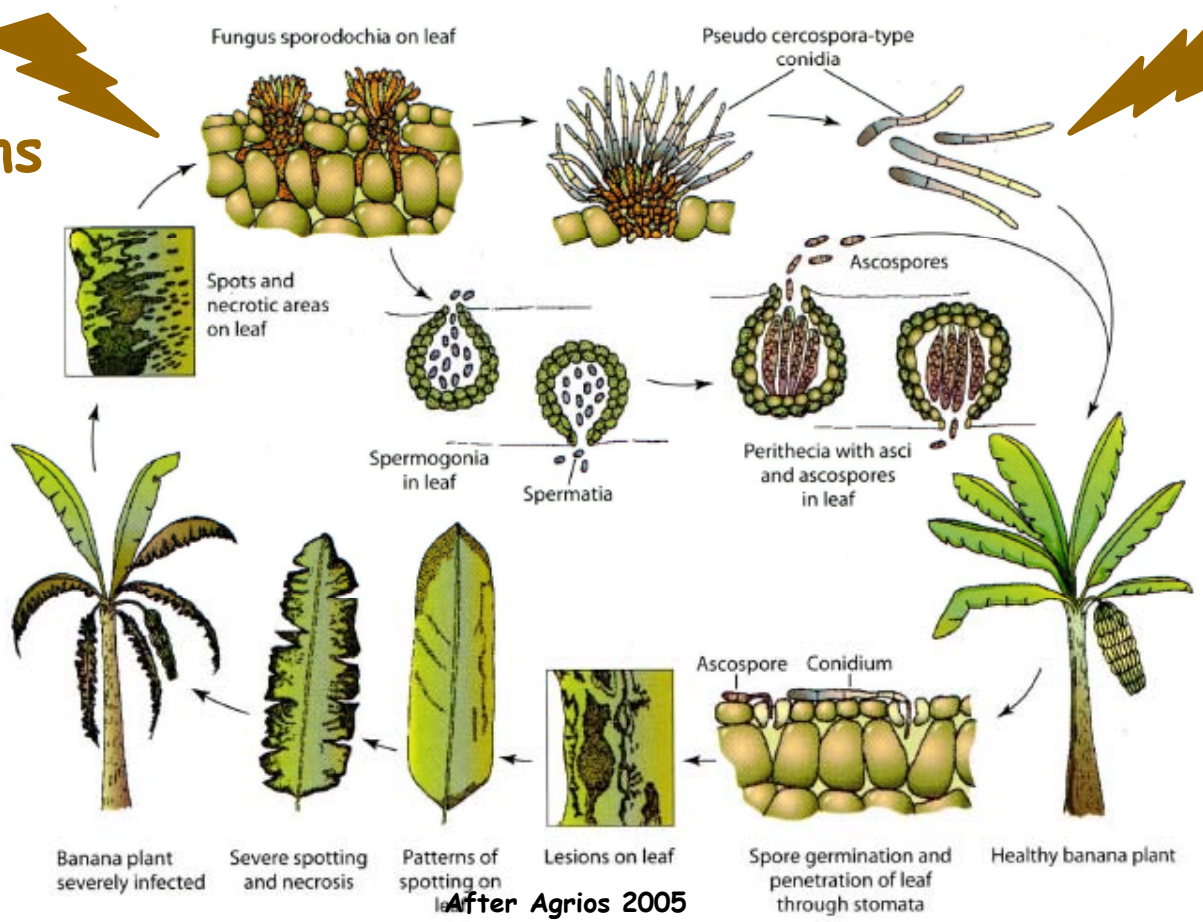
BLSD-Black Sigatoka



Eumusae leaf spot

Mycosphaerella leafspot diseases infectious cycle

hydric conditions



After Agrios 2005

- Infection on young leaves
- Long incubation time (>2 weeks)
- Symptoms : streaks ➡ necrosis
- Abundant sporulation (conidia and ascospores)

Mycosphaerella sp. dispersal modes

Occurence of 2 dispersal modes

- infected material (suckers, leaf fragments)

➡ non limited in space

- spores

➡ limited in space

Many studies on *M. fijiensis* dispersal at different scales

plot	Abadie *et al*, 2011
region	Halkett *et al.*, 2010
	Rieux *et al.*, 2011
global (world)	Robert *et al.*, 2011

Average dispersal distance : conidia : 3 m

ascospores : 282m

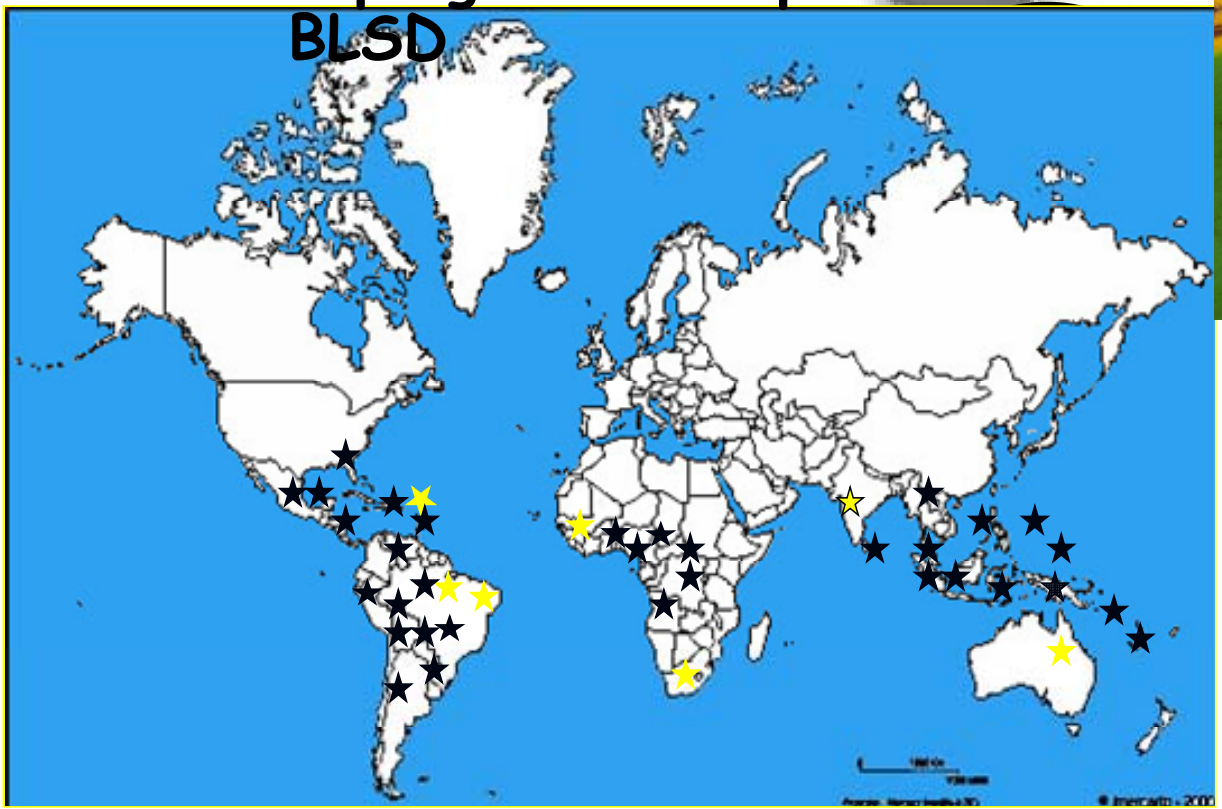
Mycosphaerella sp. origin and distribution

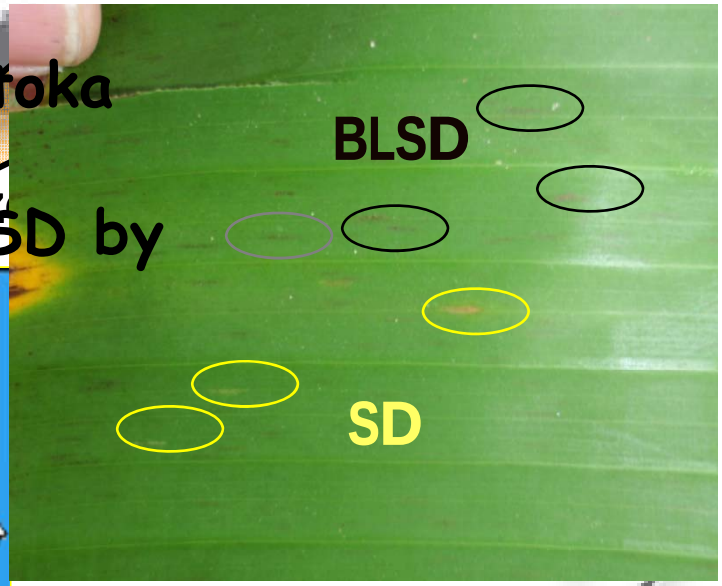
Recent invasive diseases from South-East of Asia

- Black Sigatoka: 1963 *M. fjiensis/ Pseudocercospora fijiensis*

BLSD has always invaded Sigatoka disease area

➔progressive replacement of SD by BLSD





Lesser Antilles safe of BLSD (<2010)

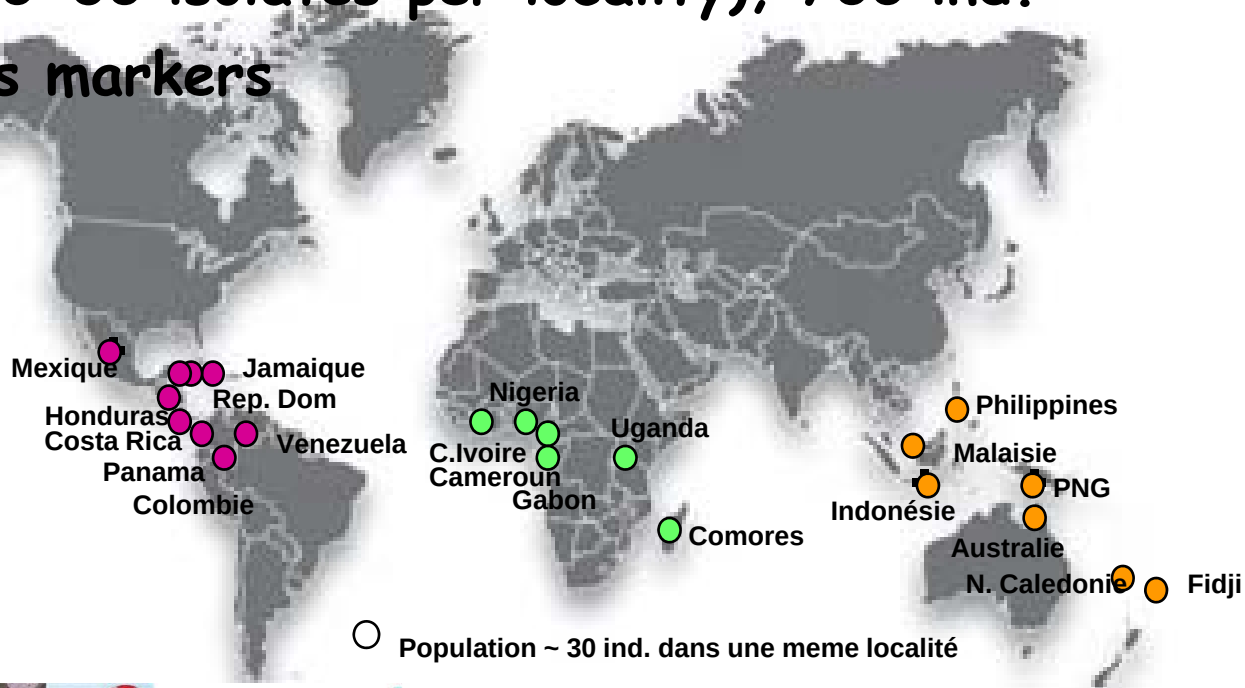
Mycosphaerella fijiensis worldwide dispersal

Understanding the global dispersal history to optimize the surveillance networks in safe areas

✓ **Sampling**

23 populations (20-30 isolates per locality), 700 ind.

21 microsatellites markers



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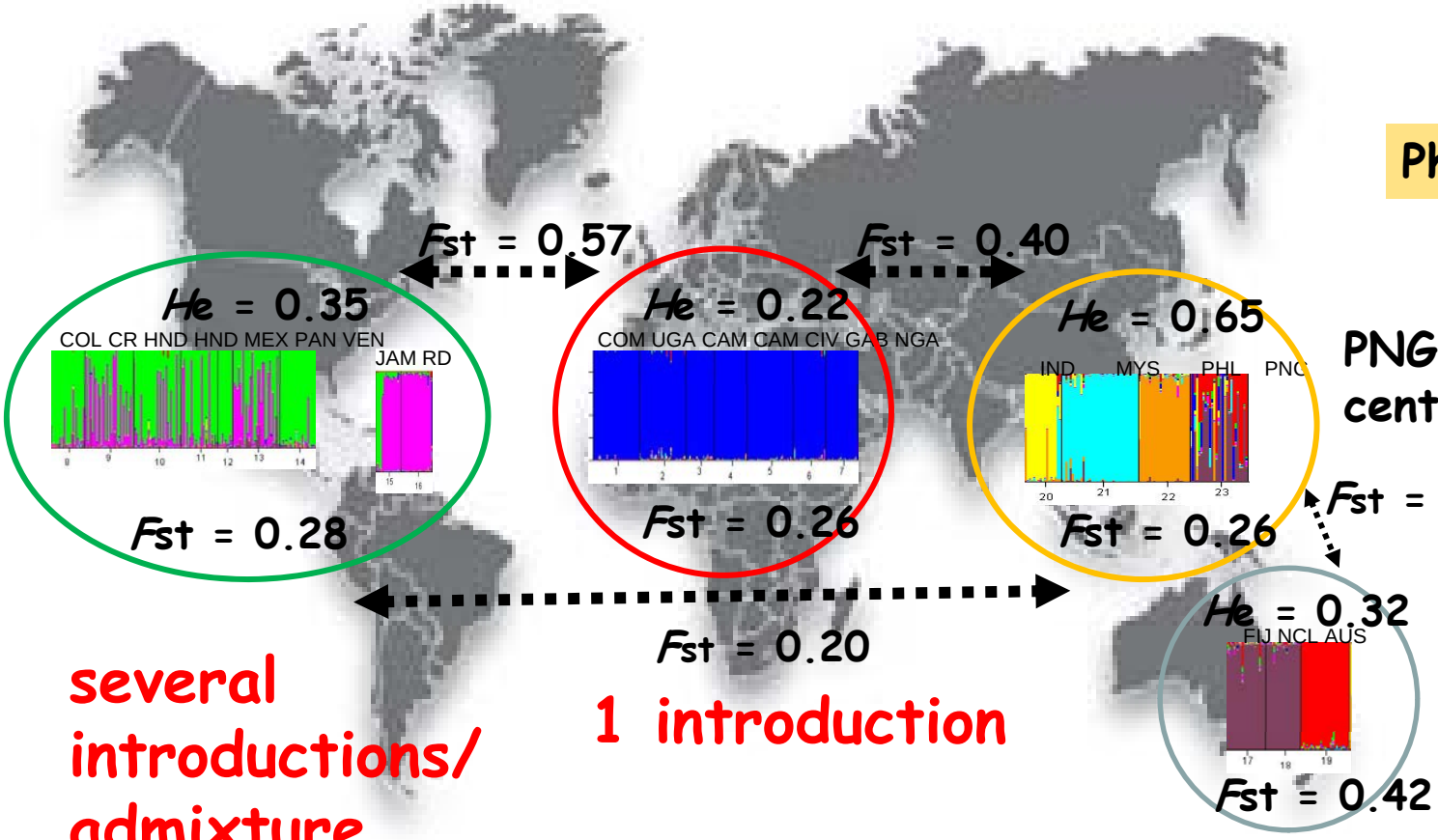
Comprendre les émergences de maladies fongiques de plantes

AgroParisTech · Université Paris-Sud 11 · INRA · ANR · CIRAD

M. fijiensis worldwide dispersal

Phylogeography approach *(Structure software)*



PhD S.Robert

PNG : origin center?

several introductions/ admixture

1 introduction

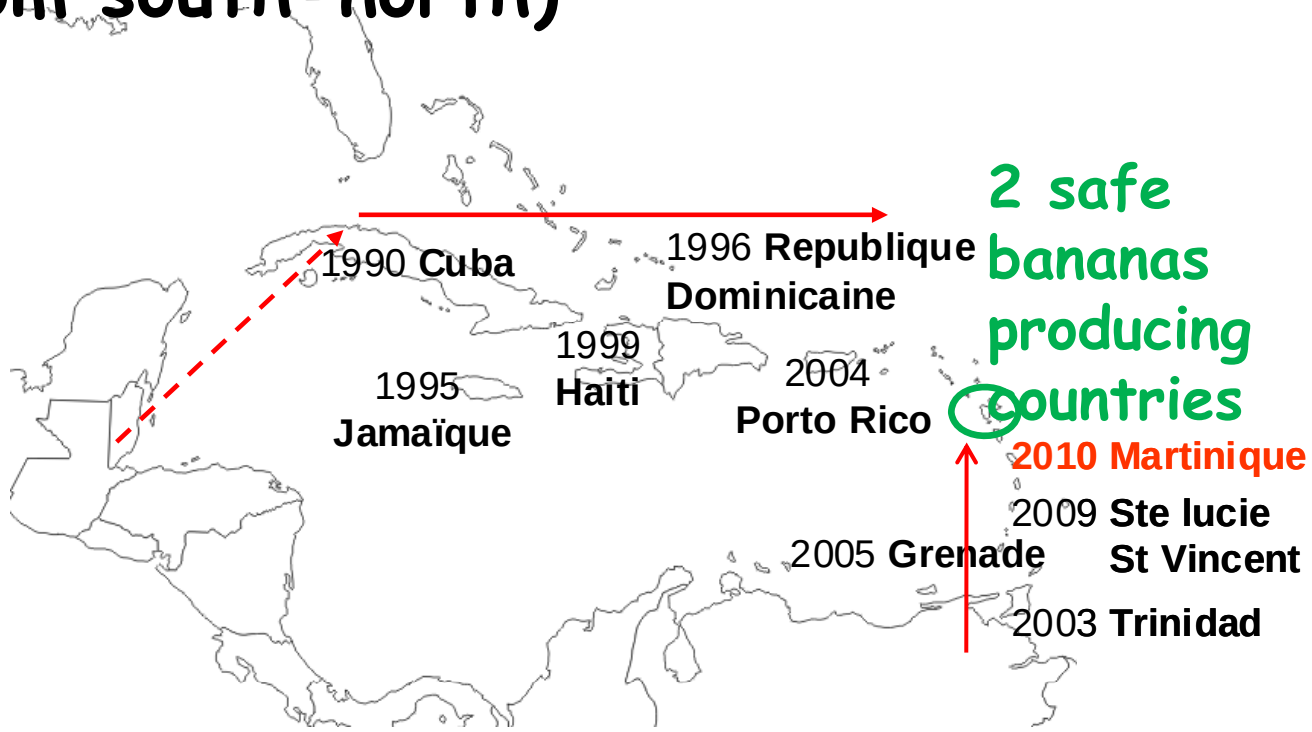
➡ Continental spread due to infected materials

M. fijiensis dispersal in the Caribbean

step 1 (1990-2000) :slow in the Greater Antilles (from west-east)

step 2 (>2000) : rapid in the Lesser Antilles (from south-north)

Introduction hypothesis from Honduras ; through infected material

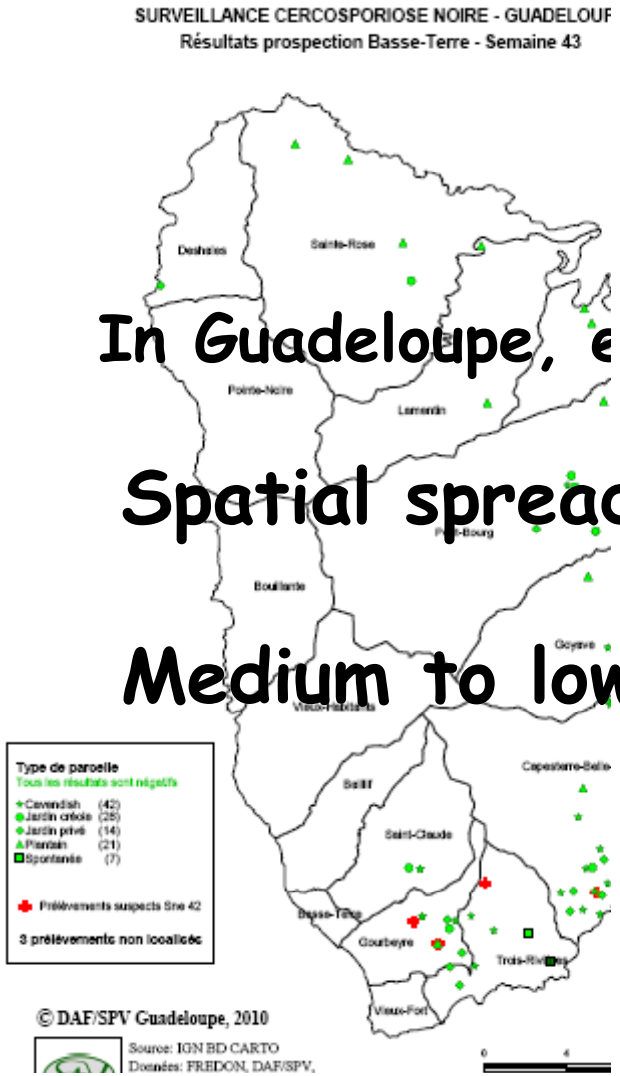


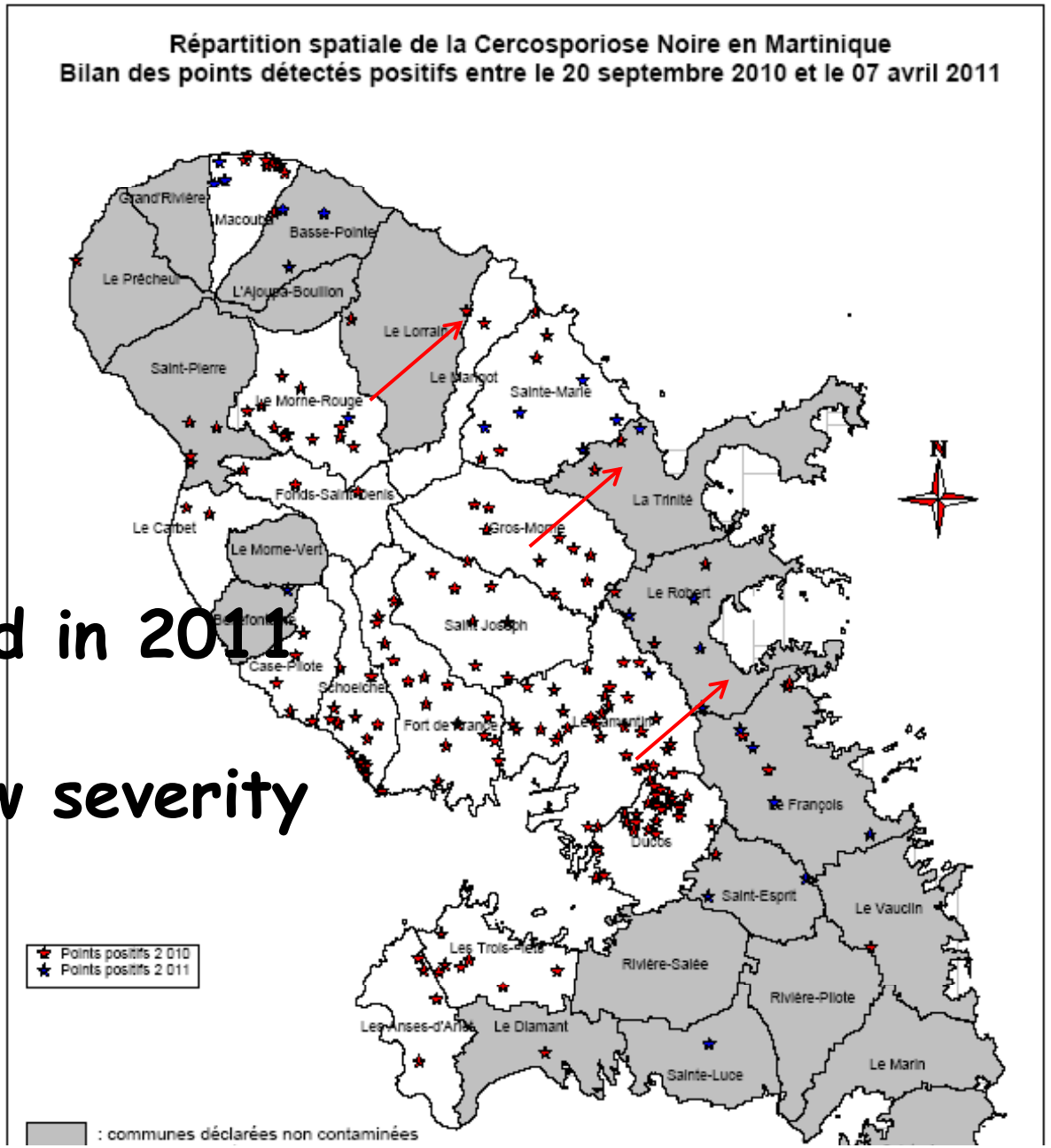
2 safe bananas producing countries

Ioos *et al.*, 2011

M. fijiensis surveillance networks in French West Indies

- Since 2008 in Martinica and 2009 in Guadeloupe
- Surveillance based on visu
diagnosis on sampled doubt
- Surveilance on export pla





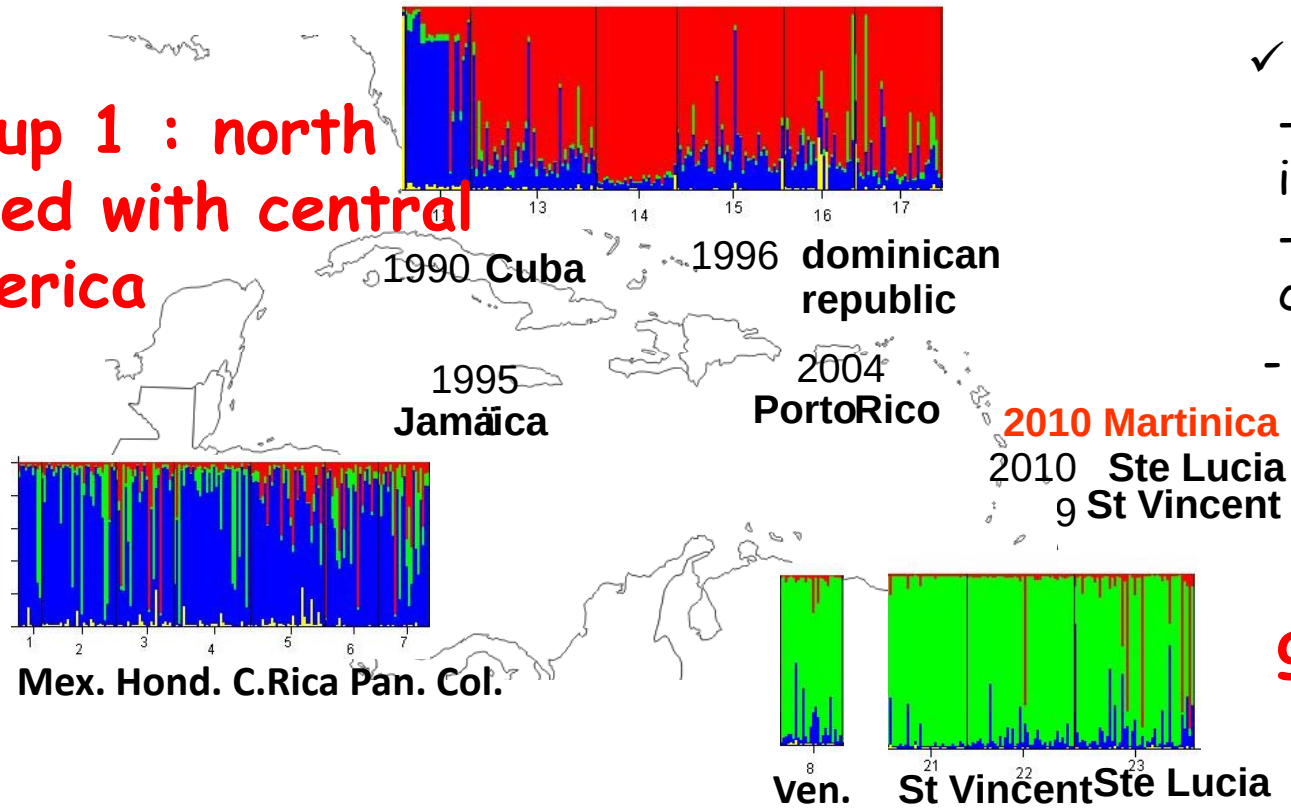
In Guadeloupe, e

Spatial spread in 2011

Medium to low severity

M. fijiensis dispersal in the Caribbean

Genetic populations approach



✓ **Sampling**

-20 Populations (20-30 isolats/loc), 500 ind.

- From Caribbeans and central-latin america

- 21 microsat. markers

- Occurrence of 2 different genetic groups: north and south ➡ Historical data
- Undergoing studies with more populations/country and every infested country to suggest hypothesis on dispersal modes

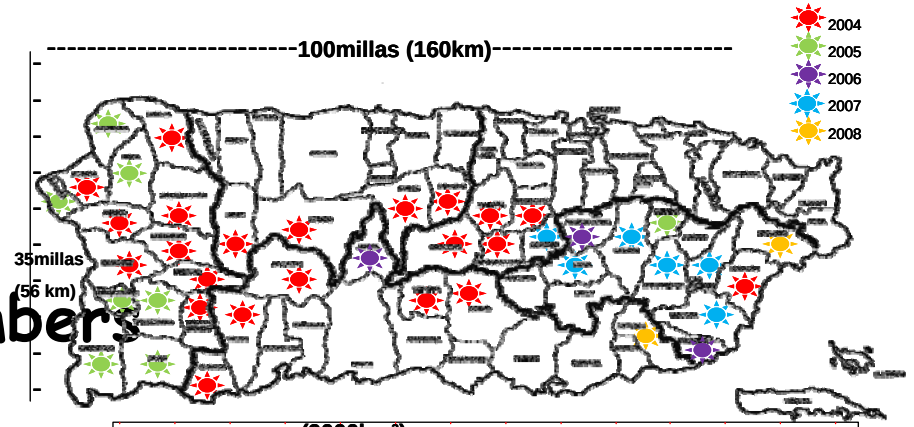
Substitution of *M.musicola* by *M.fijiensis*

Historical data analysis

✓ Survey in 9 countries

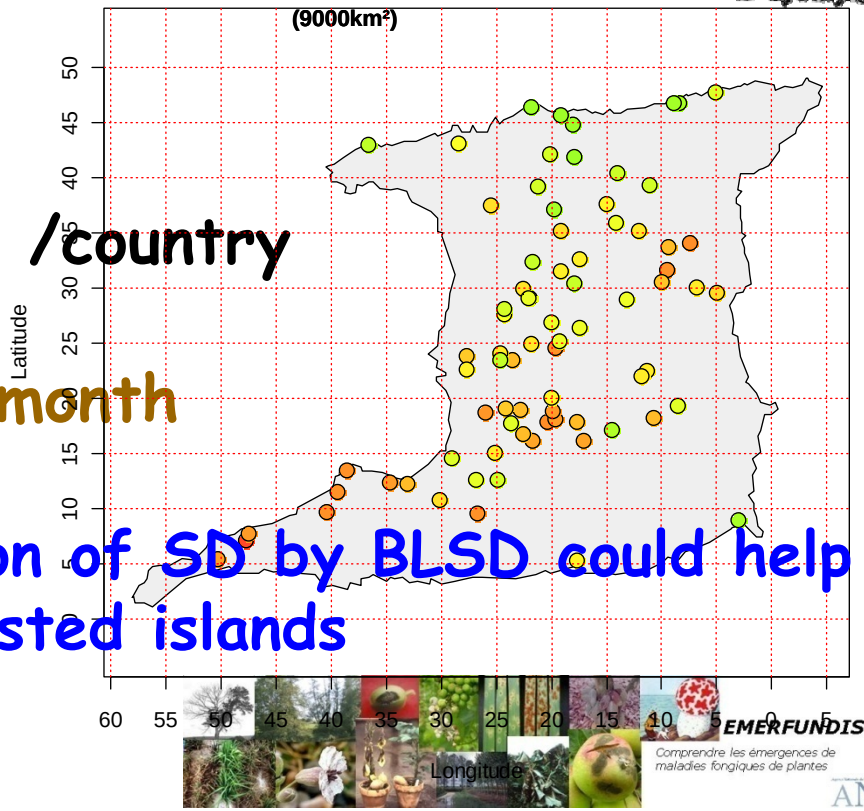
- Replacement duration :
  3 to 8 years

depending on:
modes and introductions numbers
Control methods
Bananas areas structure



•Calculation of spread speed /country

Trinidad:3 km/month



• Understanding the substitution of SD by BLSD could help to brake the spread in newly infested islands

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Mycosphaerella eumusae invasion

Second recent invasive *Mycosphaerella* leafspot disease

- *Eumusae* leafspot disease (ELSD)

SYMPTOMS

similar to those of SD but

Primary brown lesion

Oval necrosis (low pressure)

HOST RANGE

various:

Cavendish, Gros-Michel (highly infested)

Plantains

Sucrier

Pisang lilin,Mysore (partially resistant to BLSD)

Mycosphaerella eumusae pathogen

TAXONOMY

perfect stage : *M.eumusae*

imperfect stage : *Pseudocercospora eumusae*

(revised after Septoria)

Carlier et al., 2000
Crous and Mourichon, 2002

DIAGNOSIS

- morphology of conidia and conidiophores

conidiophores septate
conidia thiner and shorter than others sp.

Zapater *et al.*, 2008

- molecular markers

quantitative PCR

Arzanlou *et al.*, 2007

Mycosphaerella eumusae origin and distribution

ORIGIN

South-East of Asia

DISTRIBUTION

ELSD described in 2000

on samples collected between 1989 and 2000

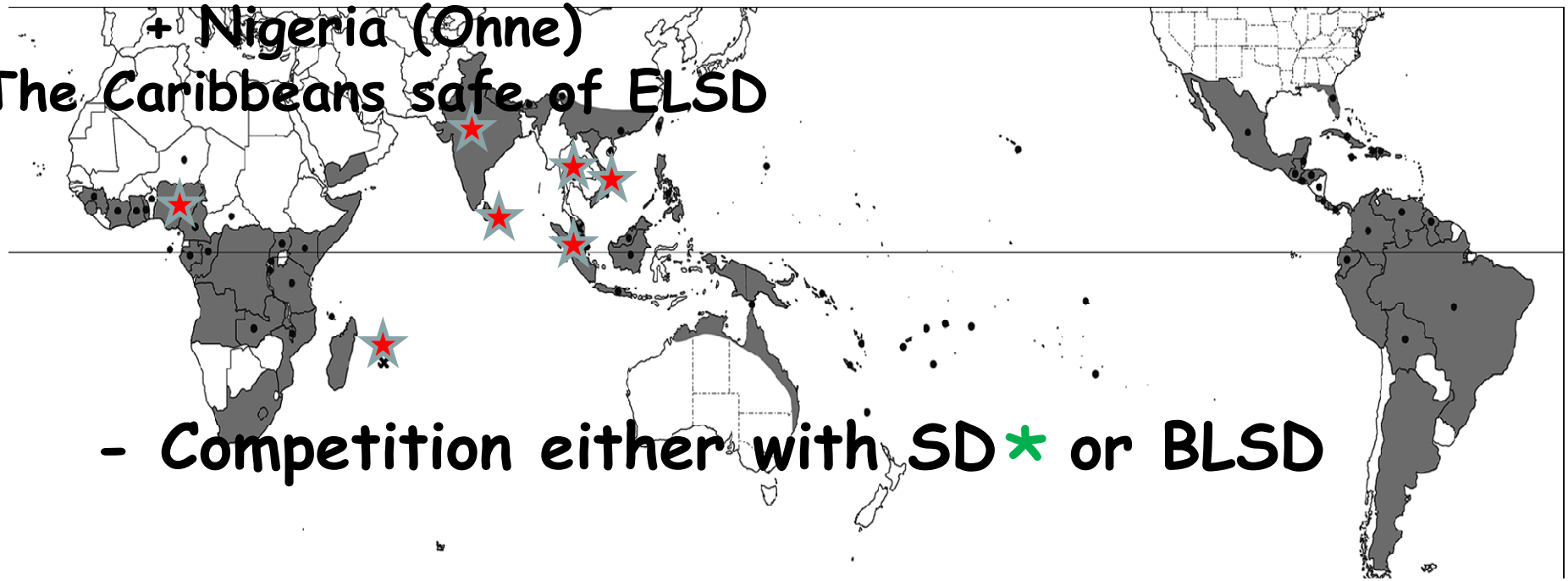
Geographically located to Southeastern Asia:

India, Sri Lanka, Thailand, Vietnam, South Malaysia

+ Mauritius and Reunion

+ Nigeria (Onne)

The Caribbeans safe of ELSD



- Competition either with SD or BLSD

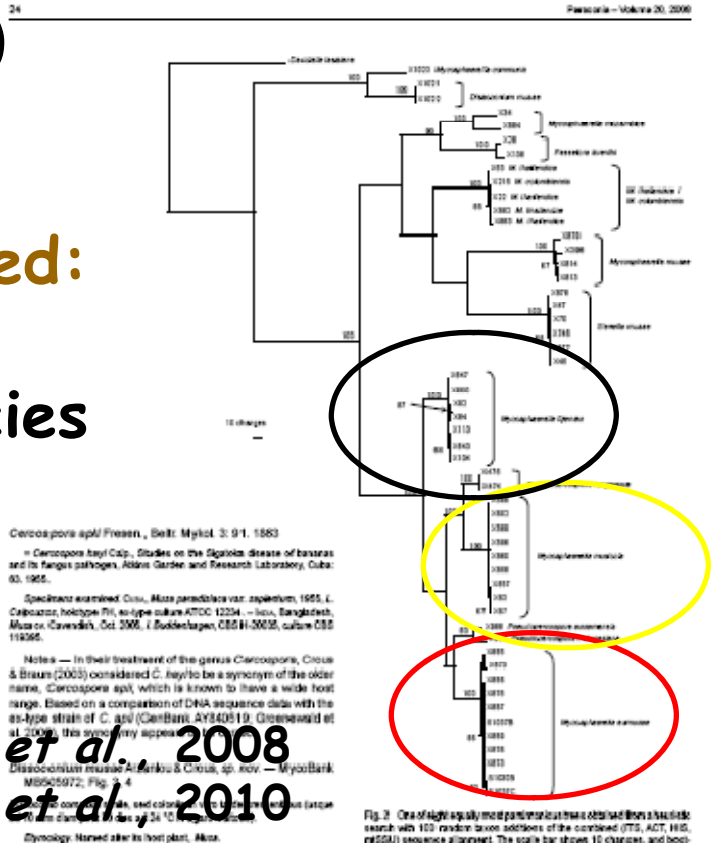
Invasion *Mycosphaerella sp.* leafspots perspectives

- Many information and development of tools occur on *M. fijiensis* (which has been sequenced)
- Further studies on *M. fijiensis* to precise the modes of dispersal in the Caribbeans
- For *M. eumusae,* many topics to study (distribution, control methods..)

Recent phylogenetic studies showed:

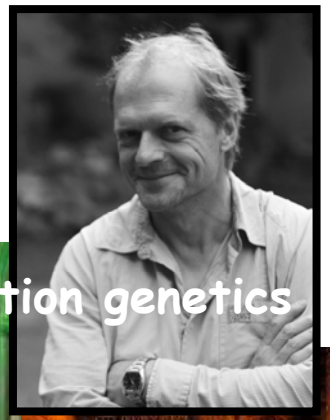
Commun ancestor for 3 main species

20 species of *Mycosphaerella* on bananas



Arzanlou *et al.*, 2008
Arzanlou *et al.*, 2010

CIRAD TEAM ON *MYCOSPHAERELLA* SP.



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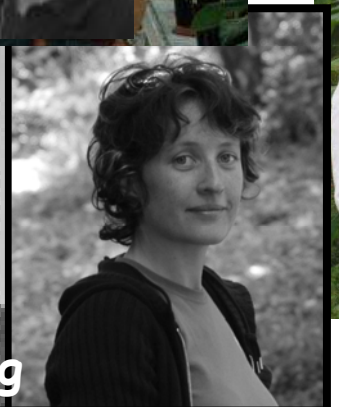
Population genetics

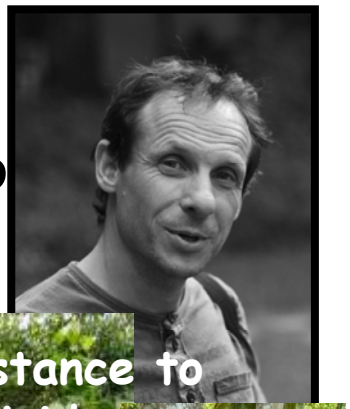
agressiveness

Modeling



PhD students

UPR 26



resistance to fungicides

Control practices

Cropping system

Epidemiology, modeling